Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

CHANGES IN THE QUALITY OF THE PUPILS ENTERING HIGH SCHOOL[1]

E. L. THORNDIKE
Teachers College, Columbia University

The facts reported here were brought together in the course of the consideration of the nature of the pupils now studying algebra in American schools. They concern teachers of English, history, languages, and science as much as teachers of algebra, however, and deserve the attention of all students of secondary education.

The mathematician or college teacher who concerns himself with the teaching of algebra tends to think of the high school and its pupils as it was when he himself attended high school. There is thus a tendency for, say, the textbook which he writes or the selection of subject-matter and methods which he advocates to be adapted to the pupils of twenty-five to thirty years ago. This tendency persists even when he visits high schools frequently and teaches their classes occasionally.

The pupils of today, however, are different from those of twenty-five years ago, not only in their experiences and interests, but also in their inborn abilities. The data available for 1918 may be compared with the figures for 1890, since the interval between a person's study of algebra as a pupil and his opinion about it as an educational expert would probably average approximately twenty-eight years.

The essential available facts are given on page 356, according to bulletins[2] of the Bureau of Education and the census report[3] of 1910. All numbers are to the nearest thousand.

---

[1] The work reported in this article was made possible by a grant from the Commonwealth Fund.

[2] "Private High Schools and Academies, 1917–18," *Bureau of Education Bulletin No. 3*, 1920, p. 4. "Statistics of Public High Schools, 1917–18," *Bureau of Education Bulletin No. 19*, 1920, pp. 11 f.

[3] *Thirteenth Census of the United States*, I (1910), 306.

Thus, the number of high-school pupils in 1918 was six times that in 1890, while the number of children of high-school age in 1918 was less than one and two-thirds times that in 1890. The number of graduates, which is in some respects a better measure, was eight times as large in 1918 as in 1890.

	1890	1918
Number of students in all secondary schools	298,000	1,804,000
Number of graduates	30,000	248,000
Total population	62,622,000	105,253,000
Population, ages 10–14	7,034,000	10,400,000*
Population, ages 15–19	6,558,000	10,400,000*

* Estimated from the total population for 1918, allowing for the general change in the distribution of the population by age groups. In 1900 there were 8,080,000 persons ten to fourteen years of age and 7,556,000 fifteen to nineteen; in 1920 there were 9,107,000 ten to fourteen and 9,064,000 fifteen to nineteen. By 1918 the numbers in these two age groups were probably approximately equal.

Neither of these, however, is just the comparison we wish. We are concerned here primarily with the number of pupils in the first year of high school (minus repeaters, since we do not wish to count a child twice because he takes the work of the grade a second time). This we would preferably compare with the number of children who passed a certain age mark, say fourteen, during the year in question.

On the basis of the primary data we may estimate the number of children who became fourteen years old during 1890 and 1918 as 1,365,000 and 2,080,000, respectively. The numbers who entered high schools and remained for four months or more in the school years 1890–91 and 1918–19 are more difficult to determine. The students in the first year of high school in recent years are about 40 per cent of the total high-school enrolment.[1] Some of these are repeaters and must be subtracted to leave the actual number entering high school that year. On the other hand, the enrolment figures omit some of the students who enter high school, study algebra for a few months, and then leave school. The percentage of repeaters is not known. About 1905 in certain cities one pupil in five failed of promotion in the first year of high school.[2] The pupils who failed of promotion would, of course, not all repeat the grade, the tendency to leave school being notably strong in those who fail. Considering these and other factors, we may set 90 per cent of 40 per cent of 1,804,000 as an approximate count of the number entering the first year of high school annually. This is almost 650,000; that is, almost one in three of the children reaching their teens in the United States enters high school.

---

[1] *Report of the United States Commissioner of Education for 1916*, I, 448.

[2] G. D. Strayer and E. L. Thorndike, *Educational Administration, Quantitative Studies*, pp. 29 f. New York: Macmillan Co., 1913.

This is a fact worth remembering. Nothing like it has ever occurred before in the world's history. The corresponding figure for 1890 is almost certainly not over one in ten.

Neither the percentage which the number of first-year high-school pupils was of the total high-school enrolment in 1890, nor the proportion of repeaters in the first year at that time is known. Since four-year high schools have been replacing schools with shorter courses, and since also the gain from 1890 to 1918 has been greater for graduates than for total enrolment, it is probable that the percentage put at 40 for 1918 should be put at 43 or more for 1890. Even if it is put as high as 46, and if we use 90 per cent of 46 per cent of 298,000 as our high-school inflow in 1890, we have an enormous change from 1890 to 1918. For every one hundred children who reached fourteen there were about three and one-half times as many beginning high school in 1918 as in 1890!

We lack measures of the inborn capacities of the one in ten or eleven of a generation ago and have only very scanty measures of the capacities of the one in three of today. We have, however, excellent reasons for believing that the one in ten had greater capacities for algebra and for intellectual tasks generally than the one in three of today.

We know that education is selective, that the correlation between native capacity and continuance in school to higher and higher grades is positive. Let us consider the effect of what seems a reasonable degree of this selective force, say that represented by a correlation of .70.[1] If the correlation is .70 and one-tenth of each oncoming age group is selected for entrance to high school and for the study of algebra, we shall have approximately the results shown in the first line of entries of Table I. If, the correlation being .70 as before, the selection is widened to one-third, we shall have approximately the results shown in the second line of entries of the table. In the former case, 95 per cent of the pupils studying algebra will be above average in native intellectual capacity; in the latter case, only 83 per cent. In the former case seven-tenths of the pupils will be in the top fifth of human beings for intellect; in the latter case, only four and one-half tenths. If we set a forty-percentile human intellect as the minimum able to profit by the study of algebra, there would be only 2½ per cent of pupils unable to profit in the one case as against ten per cent in the other. If we set the median intellect as the minimum able to profit by the study of algebra, the corresponding percentages would be 5 and 17. For readers who would estimate the selective force as greater or less than that denoted by $r = .70$, the results of similar calculations are included in Table I.

---

[1] The justification of this estimate would lead into highly technical arguments, unsuitable for presentation here. The actual data available are complicated by various factors; and their interpretation depends upon one's opinion of the relative shares of native capacity and the amount of education in determining the score made in such tests as the Stanford-Binet, the Army Alpha, and the Army Beta. The correlation

TABLE I

DISTRIBUTION OF INTELLECT IN 1,000 PUPILS OF THE FIRST YEAR OF HIGH SCHOOL ACCORDING AS ONE IN TEN OR ONE IN THREE ENTERS HIGH SCHOOL

	Lowest Tenth	Second Tenth	Third Tenth	Fourth Tenth	Fifth Tenth	Sixth Tenth	Seventh Tenth	Eighth Tenth	Ninth Tenth	Highest Tenth
Selective force: $r = .70$										
One in ten	0	2	7	15	28	48	80	130	223	467
One in three	4	17	32	47	71	95	124	157	198	255
Selective force: $r = .60$										
One in ten	2	9	18	29	46	66	97	137	204	392
One in three	12	29	45	61	80	98	121	146	177	230
Selective force: $r = .80$										
One in ten	0	0	1	4	11	26	54	111	231	562
One in three	1	6	17	35	57	89	126	170	222	277

---

between Alpha score and grade reached, as reported by the recruit, may be taken as .75; that for the Non-verbal Beta Test, .65; and that for the Stanford-Binet, .65 ("Psychological Examining in the United States Army," *Memoirs of the National Academy of Sciences*, XV, 779, 783, 805. Washington: Government Printing Office, 1920).

It may be well to note here that the different selection of pupils in the European high schools must be considered in connection with any plans to adopt in whole or in part their subject-matter or methods in the teaching of mathematics. Their selection was very much narrower, and unless they were foolish in their control of it, as by rigidity of systems of caste, wealth, and the like, they should have obtained a much higher fraction of their youth in respect to intellect than we obtain of our youth.

Just how much narrower it was, it is not important for our purpose to measure, but one case[1] may be presented. In Prussia, in 1910, the numbers of pupils in the different grades of *Gymnasien*, *Progymnasien*, *Realgymnasien*, *Oberrealschulen*, and *Realschulen* altogether were as follows: upper first, 8,788; lower first, 10,993; upper second, 14,369; lower second, 25,060; upper third, 27,966; lower third, 32,172; fourth, 35,044; fifth, 35,230; sixth, 37,071.

According to the *Stateman's Year Book*, the total population of Prussia in 1910 was 40,165,219. Estimating the number reaching a stage corresponding to our first year of high school as 30,000 and the number reaching fourteen years of age as 800,000, we have about one child in twenty-seven being selected for continuance to that educational level. The selection in 1913 was only a little wider, and in 1905 it was not very much narrower, no such increase of secondary education having been in progress there as in the United States.

---

[1] Data from Ergänzungsheft 27 of the *Centralblatt für die gesamte Unterrichtsverwaltung in Preussen*, 1910.